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LINGUISTIC CAPACITY OF VERY YOUNG CHILDREN.
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BASIC LINGUISTIC CAPACITY IS PRESENT EXTREMELY EARLY IN CHILDREN. TWO-YEAR-OLDS UNDERSTAND TRANSITIVE ACTIVE SENTENCES AND THREE-YEAR-OLDS UNDERSTAND MANY PASSIVE SENTENCES. OLDER CHILDREN (THREE-YEAR-OLDS) UNDERSTAND SOME SENTENCES LESS WELL THAN YOUNGER CHILDREN (TWO-YEAR-OLDS). THIS BRIEF DECREASE IN COMPREHENSION ABILITY IS DUE TO THE TEMPORARY OVER-GENERALIZATION OF PERCEPTUAL STRATEGIES WHICH ARE DRAWN FROM THE CHILD'S EXPERIENCE. IN THE AUTHOR'S VIEW, THE YOUNG CHILD PASSES THROUGH THREE PHASES WITH RESPECT TO THE DEVELOPMENT OF EVERY CONCEPTUAL CAPACITY--(1) DEPENDENCE ON BASIC PERCEPTUAL AND CONCEPTUAL MECHANISMS, (2) EXTENSION OF THOSE BASIC MECHANISMS BY GENERALIZATIONS DRAWN FROM EXPERIENCE, AND (3) THE DEVELOPMENT OF A BROAD CONCEPTUAL BASE WHICH MEDIATES BETWEEN THE BASIC MECHANISMS AND THE GENERALIZATIONS. THE PRESENT RESEARCH ON 263 CHILDREN SHOWS THAT THE YOUNG CHILD'S CAPACITY TO UNDERSTAND AND ACT OUT SIMPLE SENTENCES GOES THROUGH THIS KIND OF DEVELOPMENTAL SEQUENCE. (AUTHOR/AMM)

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Linguistic Capacity of Very Young Children

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Abstract

Basic linguistic capacity is present extremely early in children. Two-year-olds understand transitive active sentences, three-year-olds understand many passive sentences. Older children understand some sentences less well than younger children. This brief decrease in comprehension ability is due to the temporary overgeneralization of perceptual strategies which are drawn from the child's experience.

As children grow up they develop a series of cognitive structures to refine their intellectual mastery of the world. The conceptual structure underlying certain basic cognitive capacities appears very early. For example, children at 2/6 (two years, six months) correctly recognize numerical inequalities: they report that a short row of six clay balls has "more" balls than a superficially longer row of four balls.[1] The older child (3/6) supplements this basic capacity with a perceptual strategy generalized from his experience: "anything which looks larger is made up of more members." Although this generalization usually holds, it can produce erroneous judgments in those situations which violate the usual case; for example, the child at 3/6 incorrectly indicates that a superficially longer row of clay balls has "more" balls. Ultimately, the older child develops a more profound logical capacity which helps him decide when to use such perceptual strategies and when not to use them.

Thus, in our view, the young child passes through three phases with respect to the development of every conceptual capacity: (1) dependence on basic perceptual and conceptual mechanisms, (2) extension of those basic mechanisms by generalizations drawn from experience, (3) the development of a broad conceptual base which mediates between the basic mechanisms and the generalizations. The present research on 263 children shows that the young child's capacity to understand and act out simple sentences goes through this kind of developmental sequence.

Recent research on language comprehension in the child has demonstrated the relative ease of active over passive sentences.[2] Fraser et al noticed that many young children systematically "reverse" passive sentences, interpreting the first noun phrase as the actor and the last noun phrase as the object (e.g. they point to the picture of a cow licking a horse in response to the sentence "the cow is licked by the horse.") Fraser et al (p. 133) suggested that the passive construction may be interpreted by the child as a special form of the active construction: the child ignores the "is" and "by" in a passive sentence as "signs of some uncommon tense";

for the child these signs don't affect the "actor-action-object" word order characteristic of the active construction.

A passive sentence without semantic constraints like "the cow is licked by the horse" can be "reversed" and yield a different meaningful sentence ("the cow licks the horse"). But a sentence like "the candy is eaten by the policeman" cannot be reversed except into an absurd sentence ("the candy eats the policeman.") Turner and Rommetveit, following Slobin, argued that such semantic constraints on the nouns and verb can obviate the role of syntax in sentence comprehension. Using choice of the appropriate picture as a measure of comprehension, Turner & Rommetveit found that 77% of kindergarten children understand non-reversible passive sentences but only 48% understand the reversible passive sentences.

In the present research we were concerned with the child's mastery both of syntactic structure and semantic information. Accordingly, we asked children to act out three types of active and passive sentences (see Table 1): (a) "reversible" sentences in which the subject and the object can be reversed to yield an equally meaningful and probable sentence; (b) "semantically constrained" sentences in which reversing the subject and object produces a meaningful but improbable sentence; (c) "irreversible" sentences in which reversing the subject and object produces an impossible sentence. There were two sentences of each type: each sentence had four possible versions, active, passive, reversed active, and reversed passive.

Table 1 about here

Note that reversed sentence versions are still reversible in group (a) (e.g. a-5, a-6) but are improbable in (b) (e.g. b-5, b-6) and impossible in group (c) (e.g. c-5, c-6). Eight experimental orders of the different sentences were constructed. Each experimental order contained six sentences--two reversible sentences (one active and one passive) and one of each of the four other kinds of sentences, probable, improbable,

irreversible and impossible (two actives and two passives).[3] The experimental orders were distributed evenly within ten age groups of boys and ten age groups of girls from 2/0 to 8/0; 239 children from 2 to 5 were distributed in nine four-month groups. There was an additional group of 24 children from 5/8 to 7/0. The children were from the Boston area and were run in our laboratory or at local summer camps.

In each session the experimenter first familiarized the child with the names of a set of animals and toys. The the child acted out intransitive sentences with animals which would not occur in the critical sentences (e.g. "the duck is walking," "the dog is sleeping," "the man sits down.") When the experimenter was satisfied that the child had settled on consistent names for the toys and understood the concept of "acting out" a sentence, the child was presented with the six critical sentences, one by one. Occasionally a child refused to act out a sentence: in this case the experimenter presented the child with the two alternatives (acting them out herself) and asked the child which alternative was the one that the sentence described. Only responses which clearly acted out or chose an action involving both toys were accepted as data.[4]

Table 2 about here

The differences in semantic constraints have an obvious effect at most ages (Table 2). Improbable sentence (b-3, b-4) are easier than impossible sentences (c-3, c-4) but harder than reversible sentences (a-3, a-4). Conversely, probable passives (b-2, b-4) are easier than reversible passives (a-2, a-4) and harder than irreversible passives (c-2, c-4). Responses to irreversible active and passive sentences are significantly better than random at all ages. Responses to impossible sentences improved with age, largely due to the increase in inventive solutions to the problem of acting out a sentence which describes a physically impossible event. These facts indicate that sentences with irreversible semantic constraints (c) are responded to

at all ages in terms of what the physical world allows, rather than in terms of their syntactic properties.

The two-year-old child can understand simple declarative sentences: reversible active sentences are responded to almost perfectly, despite their lack of semantic cues to meaning. Furthermore, improbable active sentences (e.g. b-3, b-4) are understood at age 2 significantly more often than not. ($p < .01$ by binomial test, two tail) This result is true even for the youngest age group (2/0-2/3). At this age 80% of the children correctly interpret the first noun phrase of an imporbable active sentence as the actor and the last noun phrase as the object, despite the fact that this interpretation is improbable. ($p < .04$ two tail) However, the capacity to understand simple active sentences in the second year is not a simple function of the tendency to treat <u>any</u> sentence as having "actor-action-object" order. If this were the case, passives would be systematically misunderstood as much as the corresponding actives are understood (e.g. "the horse is kissed by the cow" would be interpreted as "the horse kisses the cow"). But this does not occur systematically, even when such a misunderstanding would concur with semantic constraints, as in improbable passives (b-6, b-8) (c-6, c-8). Roughly, the two year old responds correctly to all physically possible actives and responds randomly to all physically possible passives.

These semantic constraints which depend on linguistic experience have little effect in the second year. At this age the response to improbable actives is not significantly worse than to reversible actives; at the same time the response to improbable passives is better than to reversible passives and no different from the response to probable passives. While at age 2 there are no significant differences between the responses to probable and improbable sentences, at age 3 probable actives and passives are responded to better than the corresponding improbable versions (p .06 for actives, p .01 for passives by X^2). This is partly a function of the fact that improbable active and passive sentences are responded to significantly <u>worse</u> at age three than at age two. This decrease in performance is more marked and occurs earlier for girls than for ——————→

boys. Girls performance on improbable actives and passives is highest at 2/0 (71%) and drops to a low of 18% at 3/0 (Significance of decrease, $p < .02$ by X^2) Boys' performance decreases from a high of 58% at 2/0 to 23% at 4/0 ($p < .09$ by X^2). At the low points, performance on improbable sentences steadily increases with age in both boys and girls. All these facts indicate that the child of three depends more on the probability of meaning of a sentence than does the child of two. That is, the three year old child learns to use a "semantic strategy." <-- What an adult says is consistent with previous linguistic experience. Although this strategy is effective most of the time, it leads temporarily to poorer performance on those sentences which are not consistent with the usual experience.

In general, passive sentences are responses to with more errors at all ages than are corresponding active sentences. The early development of the capacity to understand passive sentences which conform to semantic constraints (b-2, b-4, c-2, c-4) could be due to the development of the semantic strategy. However, children also present a startling number of correct responses to reversible passives by the end of the third year.[5]

During a brief period older children perform worse than younger children on these sentences (Fig. 1) This temporary decrease in performance is most marked in

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Figure 1 about here

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boys although it occurs later than in girls. By age 3/8 to 3/11 boys respond to reversible passives significantly better than chance ($p < .01$ by sign test, two-tail): yet four months later their performance is below chance (significance of the difference between 3/8 - 3/11 and 4/0 - 4/3 $p < .02$ by Fisher exact probability test). The same pattern appears in the development of girls' capacity to act out reversible passive sentences although girls do not develop as high an ability, and the temporary loss of their ability occurs four months earlier[6] (significance of the difference between 3/4 - 3/7 and 3/8 - 3/11 $p < .10$ by Fisher exact probability test) These findings indicate that for a brief period the child responds primarily to the actual

order of words in a sentence. In this period he applies to any sentence a general perceptual strategy: "noun...verb...noun" corresponds to "actor, action, object". Active sentence order does predominate in actual speech so this strategy is effective, except for those infrequent sentences which do not have this order (e.g. the passive).

There is some evidence that the syntactic strategy is subordinate to the semantic strategy. Sentences with semantic constraints (all of b or c) are not affected by the syntactic strategy which decreases performance on reversible passives. Performance on other kinds of passives does not decrease at the age when the syntactic strategy appears (table 3). The syntactic strategy would produce correct comprehension in active sentences, yet performance on improbable and irreversible actives does not increase at that age. These results indicate that by the end of the third year the child primarily scans the sentence for any linguistic or physical constraint among the lexical items: if there are such constraints, then the interpretation is guided by them (independently of whether or not the constraints are followed.) Only if there are no possible semantic constraints, does the child apply the syntactic strategy "noun verb noun" corresponds to "actor action object."

In summary, the capacity to act out these simple sentences goes through three stages: (1) (2-3 years) The child understands simple declarative sentences (subject verb object) even when they are improbable. Performance on passives is near random even if the correct interpretation is aided by semantic constraints. Physically impossible sentences are responded to incorrectly. (2a) (3/0 to 4/0 for girls, 3/0 to 4/4 for boys.) Semantic probability determines the interpretation in both active and passive constructions. This strategy produces poorer performance on improbable active and passive sentences than during the preceding year. Throughout this period performance on other passives improves until period (2b). (2b) (3/8 to 4/0 for girls, 4/0 to 4/4 for boys). In sentences without potential semantic constraints any "noun-verb-noun" sequence is interpreted as "actor-action-object". This strategy produces poorer performance on reversible passives than at the immediately

preceding age. (3) (4/0 and up for girls, 4/4 and up for boys) performance on all types of sentences improves steadily.

The development of the semantic and syntactic strategies in period (2) can be interpreted as an adaptation to regularities in the speech of adults. (a) It is the case by definition that what adults say usually conforms to probabilistic semantic constraints. (b) It is the case that active constructions are more frequent than passive constructions. Thus strategies (2a) and (2b) are useful generalizations which hold most of the time. They allow the child to short-cut and extend his perceptual capacities.

This three-stage developmental sequence coincides temporally with the sequence found in our earlier research on the perception of numerical inequality. In both kinds of research we have shown that the development of perceptual strategies based on experience temporarily reduces the performance of the three-year-old. Previous demonstrations of the poor cognitive performance of the three-year-old has been taken as support for the view that many conceptual abilities are ordinarily "learned" for the first time during the fourth year or later. Our results indicate that the three-year-old child's poor performance may reflect his dependence on perceptual strategies rather than a lack of knowledge. The comparatively high capacity of the two-year-old shows, in fact, that the complex abilities we have studied are basic components of man's intellectual endowment.

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Footnotes

[1] Mehler, J. & Bever, T. G. "Cognitive Capacity of Very Young Children," Science (Oct. 1967) vol. 158, No. 3797, pp. 141-142.

[2] Fraser, C.; Bellugi, U.; Brown, R. "Control of Grammar in Imitation, Comprehension and Production." J. Verbal Learning & Verbal Behavior, 2, 121-135, 1963. Turner, E. & Rommetveit, R. "Experimental Manipulation of the Production of Active and Passive Voice in Children." Language and Speech, 10(3), 196-180, 1967. Slobin, D. "Grammatical Transformations and Sentence Comprehension in Childhood and Adulthood." J. Verbal Learning & Verbal Behavior, 5, 219-227, 1966.

[3] Every version of each sentence occurred at least once across the experimental groups and the order of the six sentences in each group was randomized. The distribution of the four sentences with semantic constraints was arranged so that if the probable or irreversible sentence was an active then the improbable or impossible sentence was a passive. This, different subjects in each age group contributed responses to probable and improbable actives and passives (e.g. if a given subject responded to an improbable passive, then the probable sentence he heard was an active.) The independence of the subject's responses justifies the comparisons by X^2 used below.

[4] The primary criterion for categorizing the child's response was his performance of the actor/action distinction. We used four categories of response: (1) absolutely correct or incorrect, in which the child demonstrated by his actions a clear presence or absence of understanding of the actor, the action, and the object. (2) correct or incorrect choice among alternatives given by the experimenter, (3) probable correct or incorrect understanding (indicated by verbal response or partial action), but failure to execute the action completely or after an inordinately long time, (4) no response. Only responses in categories (1) and (2) were included as data. Of those, the number of responses in category (2) was less than 5% in every age group except 2/0 - 2/3 and 2/4 - 2/7 in which it was 15%. There was no systematic difference in the effects of syntactic structure on responses in categories 1 or 2 (see table below and compare with Table 2 in text). The number of responses in categories 3 and 4 was less than 15% in the second year and less than 5% thereafter. The main effect of syntactic structure in the second year on child's failure to respond adequately was that the child refused to respond to most kinds of passive sentences about twice as often as to actives. (see table)

	Rev.		Prob.		Improb.		Irrev.		Imposs.	
	Act	Pass	Act	Pass	Act	Pass	Act	Pass	Act	Pass
% correct in response category 2 from 2/0 to 3/0	50	43	100	25	75	29	100	20	29	40
% responses in categories 3 and 4 from 2/0 to 3/0	6	22	8	20	11	20	5	18	18	11

[5] The performance of the children on the reversible passive was better in our experiment than reported in Fraser et al, and in Turner and Rommetveit. This may be due to increased attention that the child pays to a sentence if he himself acts it out in three dimensions, as opposed to interpreting its reflection in two

dimensions. That is, the more "distant" the child is from the experimental stimulus the more likely he is to utilize the syntactic perceptual strategy. This is analogous to the finding (Mehler & Bever) that the child is more likely to use the numerical perceptual strategy if he responds verbally to inequal quantities than if he responds by actually picking the stimulus he wants to keep.

6 A further sex difference (which mystifies us at the moment) is that boys are consistently better at responding to passive sentences of all kinds and at most ages, although they are no better at active sentences.
There was also an effect of experimental order: in general, sentences later in a session were responded to by a child of age n-months the way a child of age n+4 months responded to sentences in the first half of a session. That is, experimental experience leads a child to respond at an "older" level. The sensitivity of linguistic performance to experimental experience indicates that there may be a large variation, dependent on general experience in the exact age at which the particular capacities appear. (However, we expect there to be no difference in <u>the order</u> of their appearance.)

7 The statistical preponderance of active sentence order in actual speech is an assumption which many have made, although little work has been done to verify it. However, even if the passive construction occurs as often as the active, the young child has a tendency to interpret it as an active at least half the time. Thus, in any case, the "actor-verb-object" order predominates in the young child's <u>experience</u>.

8 This work was supported by Grant #SD-187 to Harvard University, MIT, AF 19(68)-5705, the Harvard Society of Fellows and Rockefeller University. We are particularly indebted to H. Sinclair-de Zwart at the Institut des Sciences del' Education in Geneva who helped us work out the experimental technique; to H. L. Teuber and MIT department of psychology for research support; to S. Alt for experimental assistance; to J. Epstein and P. Shane for data analysis; and to P. Carey for advice on this manuscript. We are also grateful to the many summer camps in the Boston area which extended their hospitality to us.

	ACTIVE	PASSIVE
(a)		
ORIGINAL (reversible)	(1) The horse kissed the cow	(2) The cow is kissed by the horse
	(3) The truck pushes the car	(4) The car is pushed by the truck
REVERSED (reversible)	(5) The cow kisses the horse	(6) The horse is kissed by the cow
	(7) The car pushes the truck	(8) The truck is pushed by the car
(b)		
ORIGINAL (probable)	(1) The mother pats the dog	(2) The dog is patted by the mother
	(3) The girl holds the cup	(4) The cup is held by the girl
REVERSED (improbable)	(5) The dog pats the mother	(6) The mother is patted by the dog
	(7) The cup holds the girl	(8) The girl is held by the cup
(c)		
ORIGINAL (irreversible)	(1) The policeman eats the candy	(2) The candy is eaten by the policeman
	(3) The boy drinks the water	(4) The water is drunk by the boy
REVERSED (impossible)	(5) The candy eats the policeman	(6) The policeman is eaten by the candy
	(7) The water drinks the boy	(8) The boy is drunk by the water

TABLE 1

The sentences used in the experiment

		REVERSIBLE		PROBABLE		IMPROBABLE		IRREVERSIBLE		IMPOSSIBLE	
Age	N	Act.	Pass.	Act.	Pass.	Act.	Pass.	Act.	Pass.	Act.	Pass.
2 to 3 yrs	83	95	38	93	49	69	49	93	63*	25	30*
3 to 4 yrs	79	100	58	97	74	55	38	100	82	51	17
4 to 5 yrs	77	100	61	100	78	82	25	100	89	58	21
5 to 6 yrs	24	100	96	100	100	89*	55	100	90*	88*	50

TABLE 2

% sentences correct for boys and girls summarized by sentence type and age. All percentages over 65% or under 30% are significantly different from random, p .01 by the binomial test, two tail. Percentages different from random p .05, two tail are indicated with an asterisk.

Age Girls	Boys	Probable and Irreversible		Improbable and Impossible	
		Active	Passive	Active	Passive
3/4	3/8	100	78	63	31
3/8	4/0	100	81	37	25
4/0	4/4	100	89	71	31

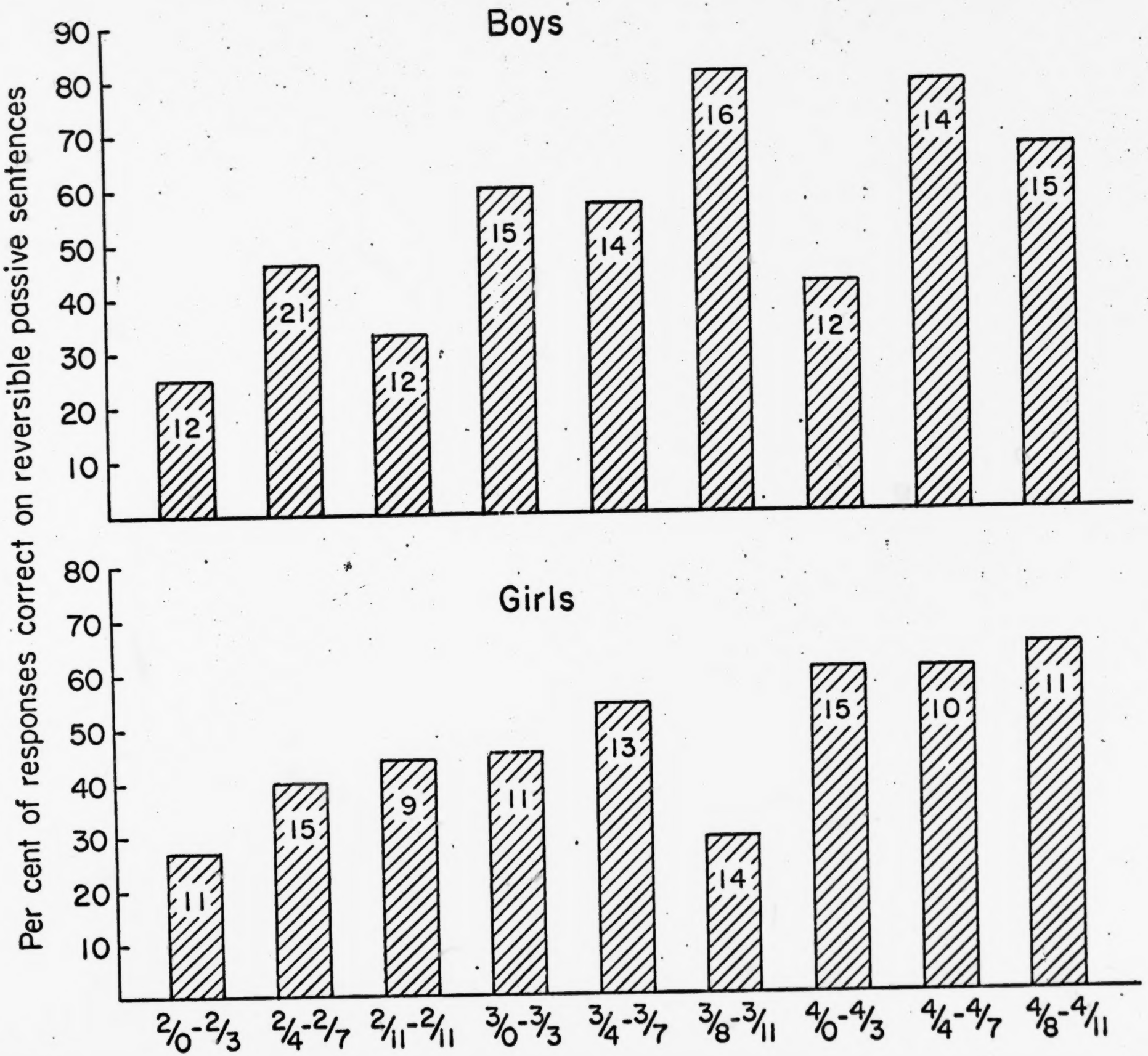
TABLE 3

% sentences correct for the age in which the syntactic strategy appears and the preceding and following ages.

Legend for Figure 1

Figure 1

The proportion by age and sex of acting out (or choosing) the correct interpretation of reversible passives sentences. The number inside each bar indicates the number of subjects at that age responding to the reversible sentence. (Each subject contributed one response.)


Boys
Per cent of responses correct on reversible passive sentences
90
80
70
60
50
40
30
20
10
12
21
12
15
14
16
12
14
15
Girls
80
70
60
50
40
30
20
10
11
15
9
11
13
14
15
10
11
2/0-2/3
2/4-2/7
2/11-2/11
3/0-3/3
3/4-3/7
3/8-3/11
4/0-4/3
4/4-4/7
4/8-4/11